JAMES W. WALTERS

AN AERIAL SURVEY AND EVALUATION OF OAK DECLINE ON THE MARK TWAIN NATIONAL FOREST, MISSOURI-1980

by

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INTRODUCTION

During 1978 and 1979, the Forest Pest Management Staff in St. Paul received several reports of dying sawtimber-size oaks on the Mark Twain National Forest in Missouri. An aerial survey with subsequent ground examinations of the affected forest units was conducted during the summer of 1980 to determine the location, extent, and cause of oak death.

METHODS

An aerial sketch-map survey of three units (Rolla-Houston, Salem-Potosi, and Fristoe) of the Mark Twain National Forest in southeastern Missouri was conducted by our staff on August 19-21, 1980. A Cessna 172 flying at approximately 1500 ft. (457 m) above ground level at a speed of 90 mph (145 kmph) on 2 mile (3.2 km) east-west flight lines was used for sketchmapping areas of oak with dieback and browned foliage. Areas containing affected oaks were plotted on 1/2-inch to the mile National Forest maps. Notations of whether symptomatic oaks were scattered in the area (1-2 oaks/acre) or heavily concentrated in the area were also made.

At least 12 areas per unit observed during the aerial survey to contain affected oaks were ground checked during the week of September 15-19, 1980. Data recorded during this portion of the survey included location, site characteristics, species of oak, damage symptoms, and cause of the damage.

Monthly climatological data reports published by the National Oceanic and Atmospheric Administration were used to evaluate the weather in southeastern Missouri over the past decade. Average temperatures, precipitation, and number of days above 90° F (32° C) and below 0° F (-18° C) were examined for this period of time to determine if and when departures from the mean values for these variables occurred. Van Buren, MO was chosen as the source of these data because it is located in the area of most injury and it is representative of the general weather pattern of the entire survey area. If data for Van Buren were missing, values from the nearest reporting station were used.

RESULTS

Aerial Survey

Many areas of affected oaks were observed during the aerial survey (Figure 1, 2, 3, and Table 1). The Fristoe Unit was the most severely affected, especially in the area southwest of Van Buren, MO. Although symptomatic oaks were occasionally scattered (1-2 trees/acre), they usually occurred in heavier concentrations.

Oaks on approximately 10,000 acres (4,000 ha) of 1,280,000 acres (518,000 ha) surveyed were affected.

MARK TWAIN NATIONAL FOREST
ROLLA - HOUSTON UNIT
OAK DECLINE AERIAL SURVEY 1980

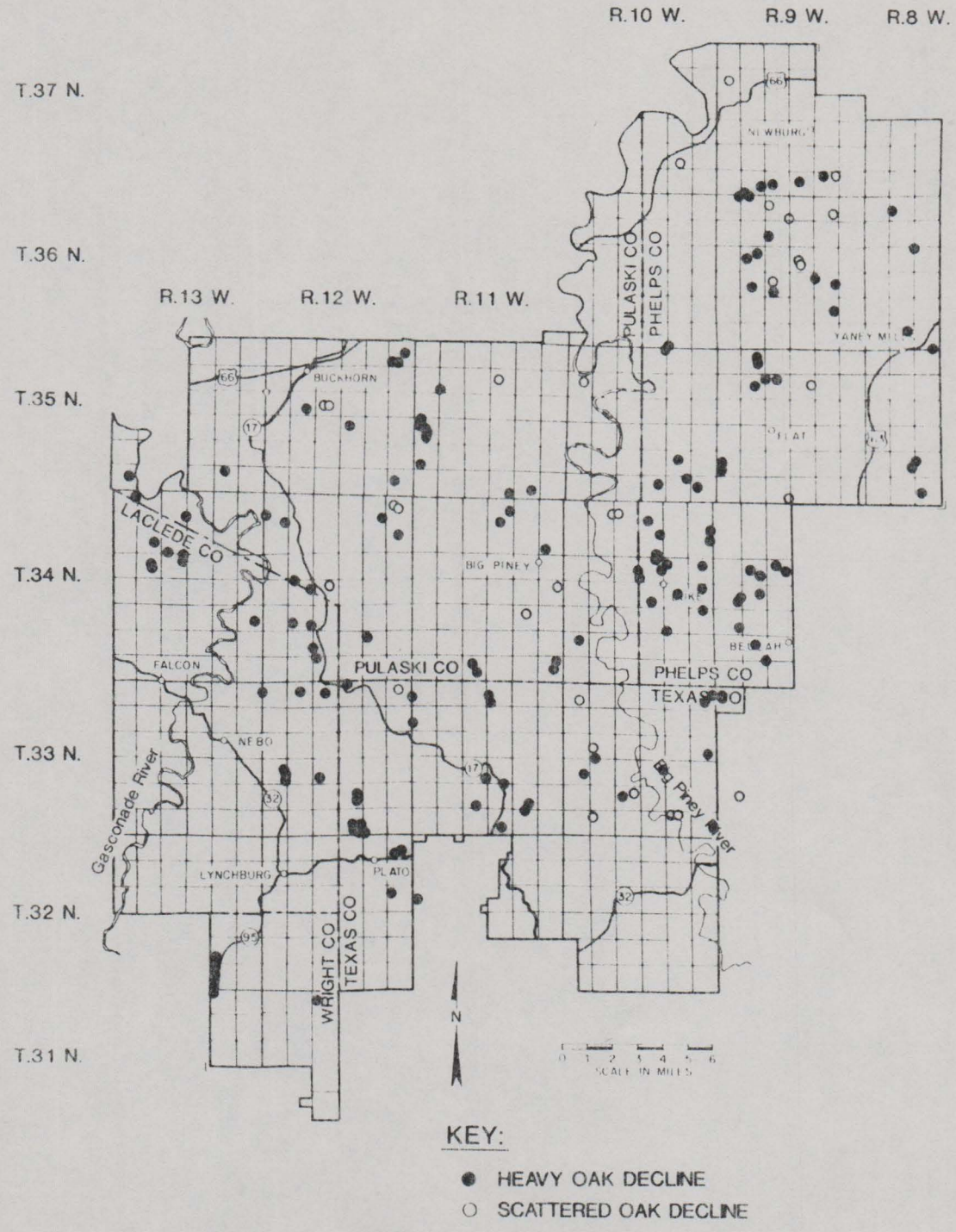

Figure 1.--Location of oak decline on the Rolla-Houston Unit, Mark Twain National Forest - summer, 1980

MARK TWAIN NATIONAL FOREST
SALEM - POTOSI UNIT
OAK DECLINE AERIAL SURVEY 1980

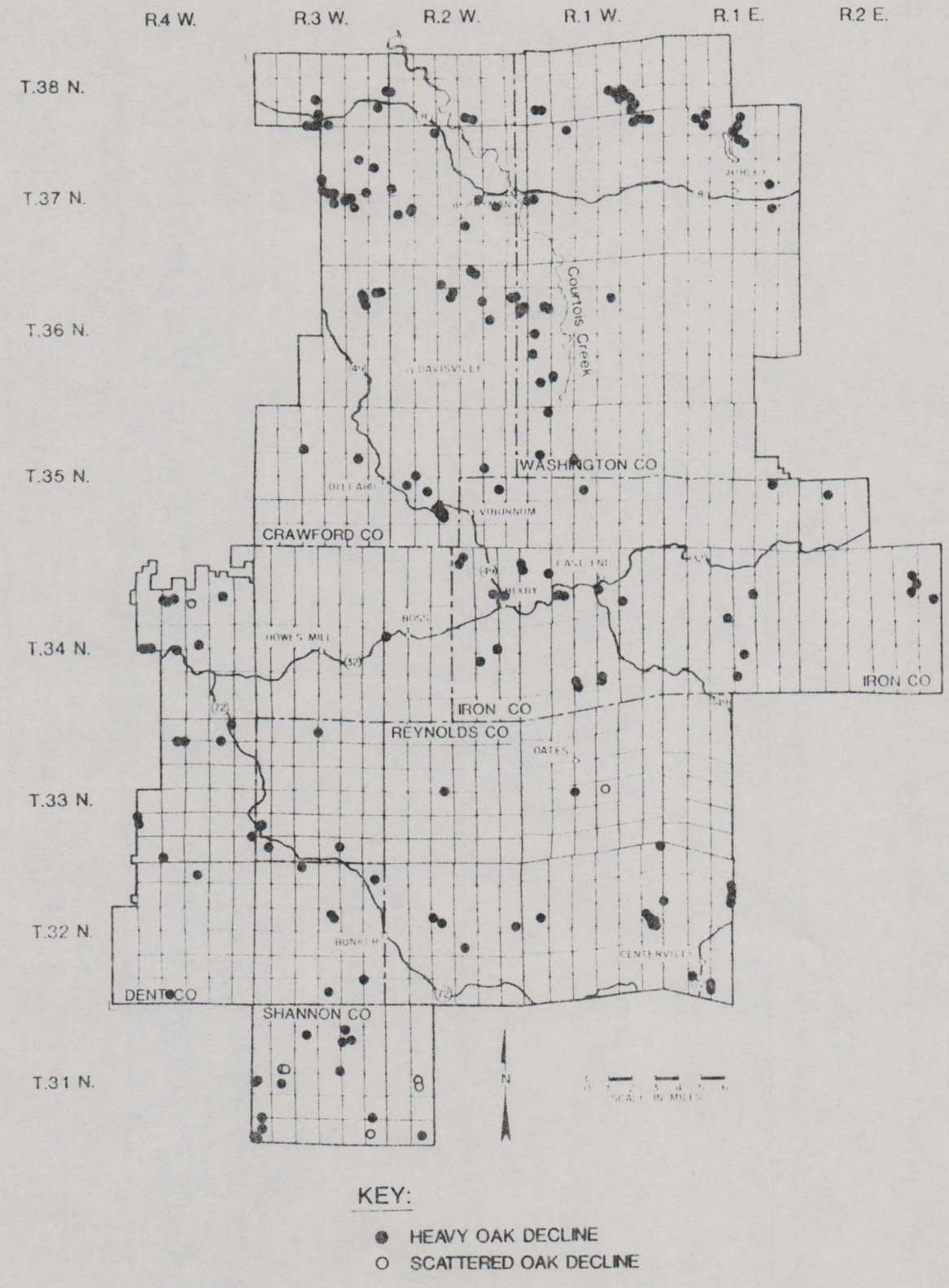

Figure 2.--Location of oak decline on the Salem-Potosi Unit, Mark Twain National Forest - summer, 1980

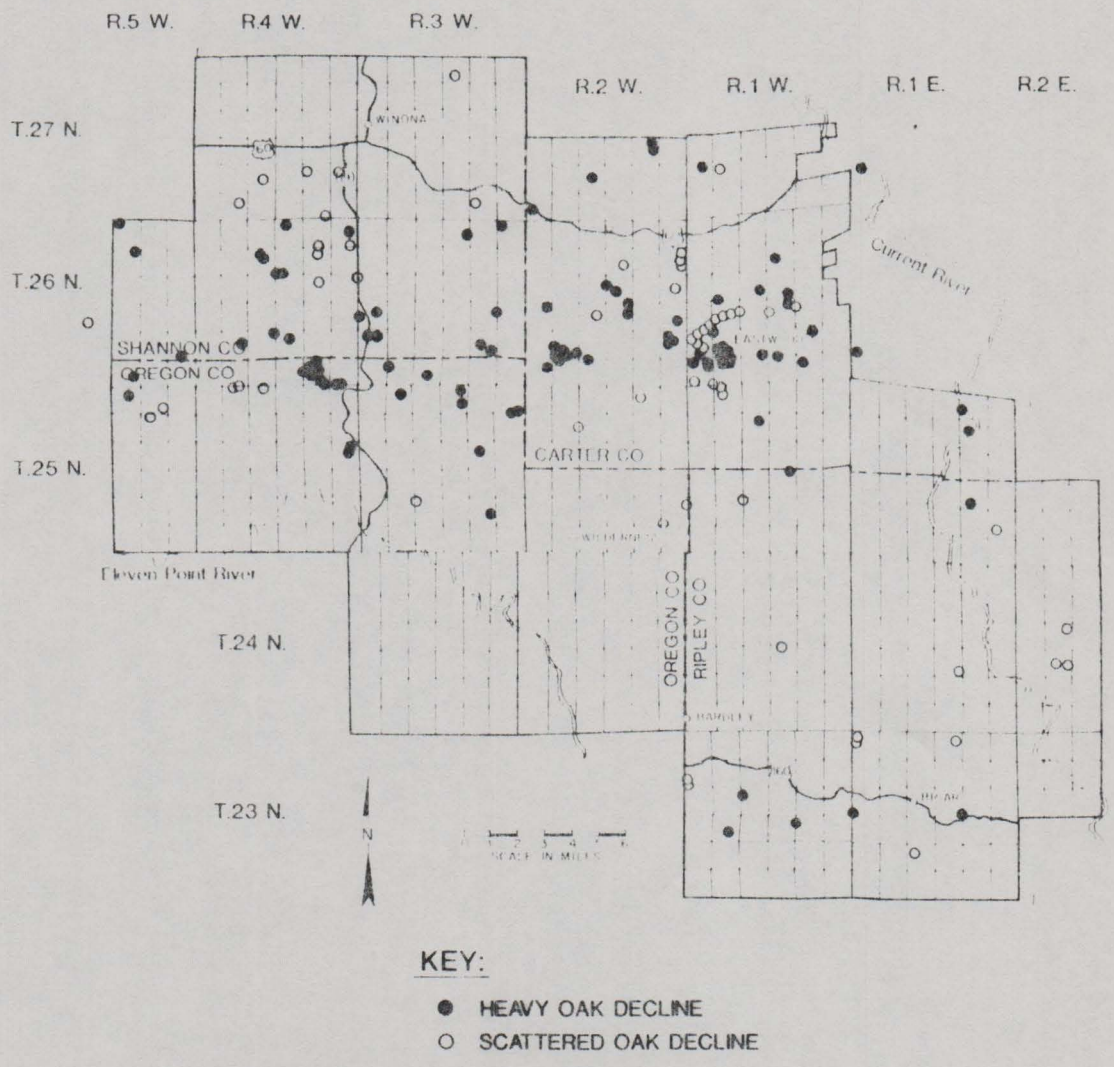

Figure 3.--Location of oak decline on the Fristoe Unit, Mark Twain National Forest - summer, 1980

Ground Checking

During ground checking, two general classes of symptoms were observed. The first involved a progressive dieback of upper branches followed by invasion of secondary organisms, which may kill affected trees. Examples of secondary organisms are the two-lined chestnut borer (Agrilus bilineatus (Weber)), oak borers (Cerambycidae), and the stem canker fungus Hypoxylon atropunctatum.

The second type of damage was characterized by leaf scorch and premature defoliation. Scorch involves the browning of leaves from their margins inward due to warm, drying winds during periods of drought and/or high temperatures. Very few oaks in this symptom class had been invaded by secondary organisms.

Species of oaks most commonly affected by both types of damage were black oak (Quercus velutina Lam.) and scarlet oak (Q. coccinea Muenchh.). Blackjack oak (Q. marilandica Muenchh.), post oak (Q. stellata Wangenh.), and white oak (Q. alba L.) were less frequently affected and most showed symptoms of leaf scorch rather then dieback.

The location of most damage was along ridge tops and on south-facing slopes. Ground checking confirmed that most of the damage was on the Fristoe Unit.

Only one area of significant insect defoliation was located (T37N, R1W, Sec. 2; T38N, R1W, Sec. 34 and 35). Although there was no evidence of the specific insect involved, it appeared to be a late season defoliator which fed on hickory as well as oak leaves.

Weather Data

Monthly weather data for 1970 - 1980 are summarized in detail in Tables 2-5. Figures 4, 5, and 6 compare yearly totals for precipitation and number of days greater than or equal to 90° F and less than or equal to 0° F with their respective ten year mean. Notable deviations from the mean include the 18-inch (45 cm) precipitation deficits in 1976 and 1980, the prolonged period of very high temperatures in 1980, and the abnormally cold winters of 1976-77 and 1978-79.

DISCUSSION

Oak decline has been reported for several species of oak from many different states (Boyce and Speers 1960; Skelly 1972; Staley 1965; True and Tryon 1956; Walters and Munson 1980). All reports describe a progression of symptoms similar to those seen in Missouri during the past few years.

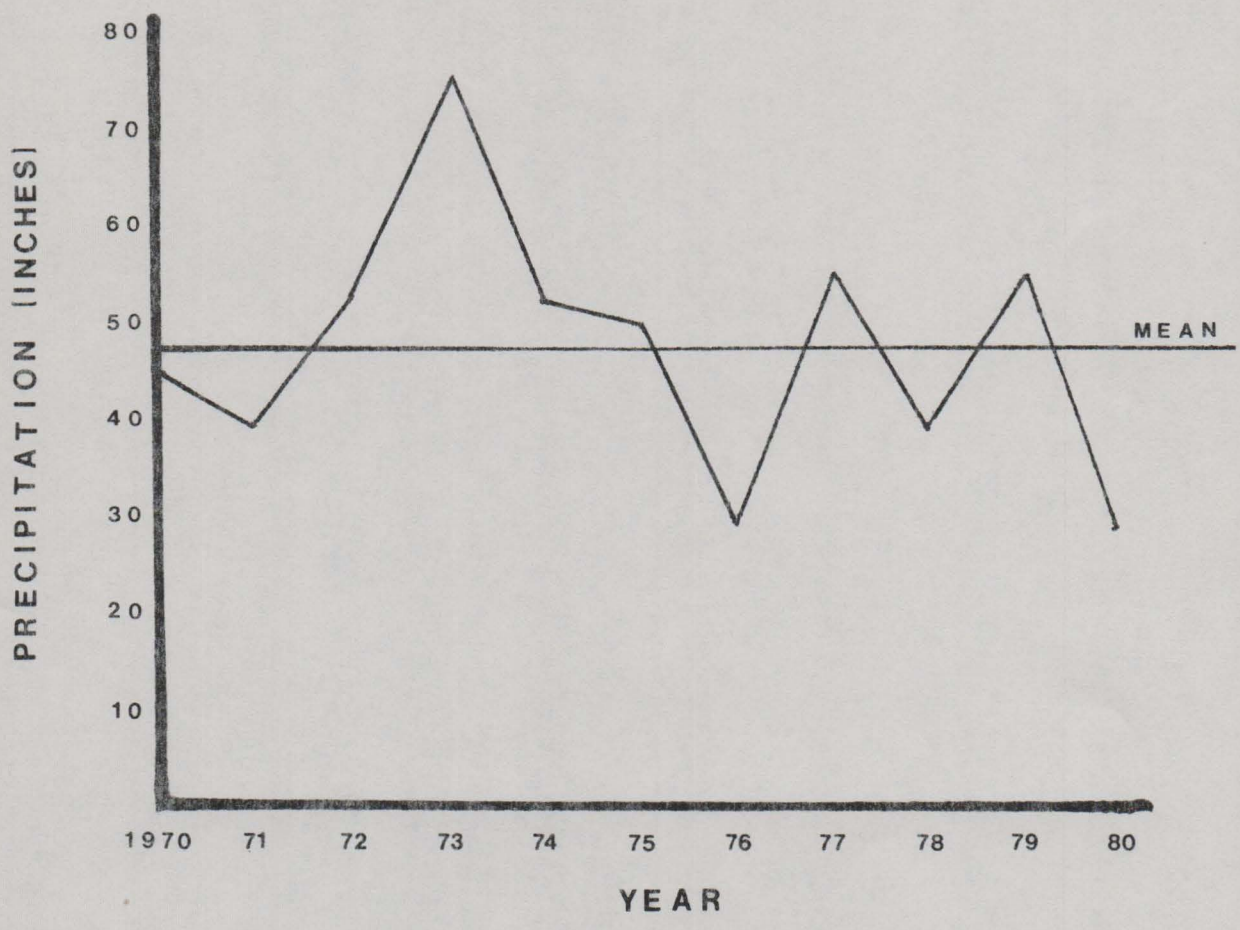

Figure 4.--Yearly precipitation in Van Buren, MO from 1970-1980 compared to a 10-year mean

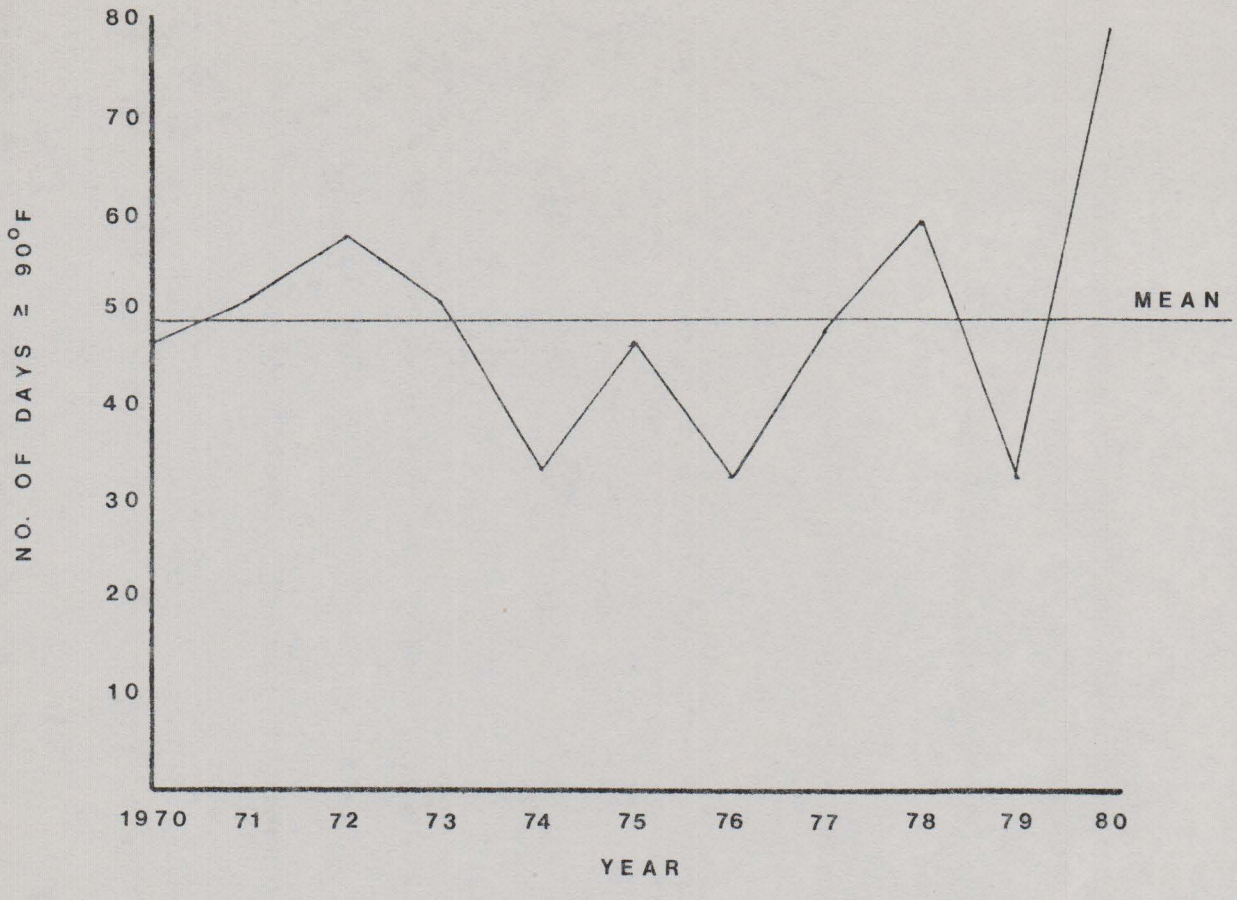

Figure 5.--Number of days with a maximum temperature of 90° F or more in Van Buren, MO from 1970-1980 compared to a 10-year mean

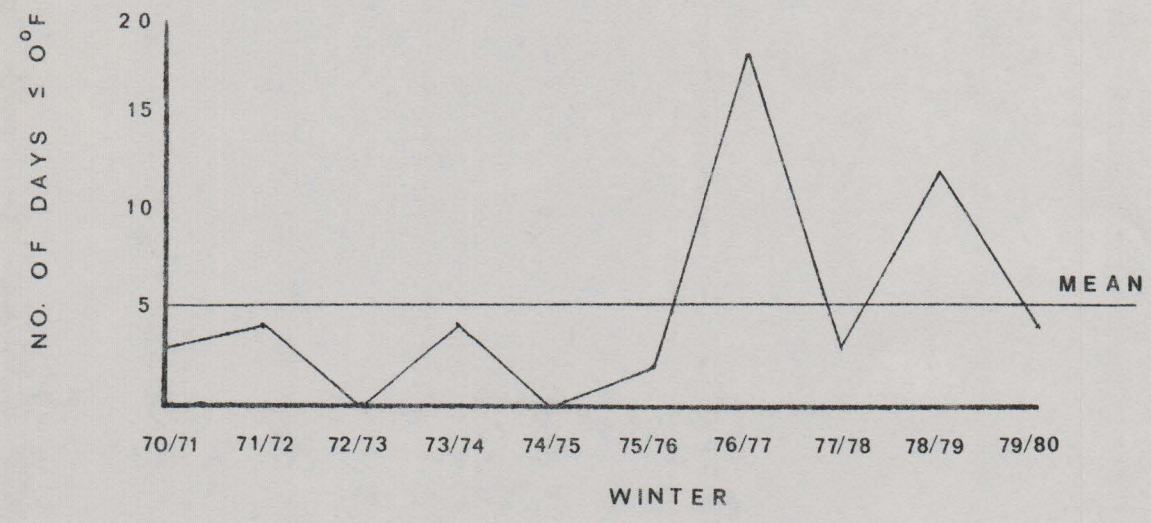

Figure 6.--Number of days with a minimum temperature of 0° F or less in Van Buren, MO from 1970-1980 compared to a 10-year mean

The cause of such declines is generally attributed to factors which stress the trees. Insect defoliation, late spring frosts, drought, and high temperatures are the most likely stress factors involved. Trees weakened by stress are more susceptible to attack by secondary insects and diseases which are not usually able to kill healthy, vigorous trees.

In Missouri, drought, high summer temperatures, and severe winters were the major causes of stress. Insufficient soil moisture causes leaf dessication and reduced growth of affected trees. While high temperatures can kill plant cells directly, injury usually involves leaf dessication due to associated low humidity and warm winds. Cold winter temperatures may kill young roots of trees, especially if there is no snow cover on the ground to act as a layer of insulation (Agrios 1973).

The effects of climate on tree growth and diseases can be due to both short term and long term changes in the climate. There is evidence of departures from normal weather during the past five years (Figures 4, 5, and 6), but small changes in average temperature or precipitation over the last several decades could also be involved in the decline of oaks (Hepting 1963; Layser 1980).

The rate at which declining oaks die and become unmerchantable is difficult to predict. Oak species seem to differ in their susceptibility to drought and/or secondary organisms. The vigor of affected trees prior to the onset of stress, the quality of sites on which such trees are growing, and the kind and quantity of secondary organisms present in the area are involved in the rate of decline. Many of the symptomatic oaks seen during the ground checking were on poor sites with thin, gravelly soil. Death can occur as much as ten years after initial symptoms appear. However, once dead, trees are rapidly invaded by insect borers and decay fungi.

Populations of the two-lined chestnut borer will probably increase because of the larger number of breeding sites provided by the dead and dying oaks suitable for attack.

Most of the trees which experienced leaf scorch and early leaf fall in the summer of 1980, but which did not show symptoms of decline previously, will probably leaf out in the spring and suffer only slight growth reduction. However, others will begin to decline slowly as did those affected by the drought of 1976. Still others may not leaf out at all in 1981 because they were killed by the extreme climatic conditions of the summer of 1980.

RECOMMENDATIONS

Where feasible, merchantable declining and dead oaks should be salvaged before defects caused by insect borers and decay fungi render the wood unusable. Dead oaks and oaks with severe dieback should be harvested first because they have suffered longer from the affects of stress and secondary organisms.

Since the causes of oak decline are generally climatic, no direct controls are possible. However, the impact of future droughts may be reduced by: 1) thinning oaks earlier in their rotation and 2) regenerating tree species more drought resistant than black and scarlet oak.

ACKNOWLEDGMENT

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Table 1. Area on the Mark Twain National Forest affected by oak decline and leaf scorch - summer 1980

National Forest Unit	Heavy (acres)	Scattered (acres)
Rolla-Houston	1329	2125
Salem-Potosi	2151	282
Fristoe	2610	1638
Total	6140	4045

Table 2.--Average monthly temperatures (°F) in Van Buren, MO from 1975-1980

Year	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
1975	35.9	35.8	41.0	55.9	66.3	71.8	77.0	76.9	64.4	58.7	49.4	36.5
1976	30.0	43.4	51.2	57.3	58.9	69.3	75.4	72.3	66.5	50.7	36.6	32.1
1977	18.5	35.0	49.7	59.4	68.0	73.8	79.2	77.4	71.1	55.9	48.7	34.5
1978	24.4	27.1	41.0	58.6	63.9	72.0	78.6	76.5	71.2	54.1	48.4	34.9
1979	19.9	29.2	46.4	55.3	62.2	70.9	76.1	74.9	66.6	57.7	43.5	36.7
1980	34.2	30.3	40.6	54.3	64.3	73.1	82.4	80.8	72.2	----	----	----
MEAN	27.2	33.5	50.0	56.8	63.9	71.8	78.1	76.5	68.7	55.4	45.3	34.9

Table 3.--Monthly Precipitation (inches) in Van Buren, MO from 1970-1980

Year	Month												
	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1970	0.80	1.82	4.95	4.18	2.90	5.35	1.28	9.22	3.86	4.86	2.75	2.51	44.48
1971	3.07	3.34	1.27	2.03	4.45	4.07	4.24	3.86	2.90	0.65	2.11	7.90	39.89
1972	3.85	3.32	1.81	6.32	2.74	2.45	8.54	1.90	3.94	5.09	7.72	5.26	52.94
1973	3.84	2.15	9.04	17.06	7.19	5.01	3.76	2.56	5.61	5.67	7.24	6.00	75.13
1974	2.76	3.22	4.37	5.11	7.47	5.13	2.59	6.43	6.64	1.32	5.69	2.14	52.87
1975	4.13	4.07	10.10	2.84	4.13	4.01	1.72	3.20	4.60	1.91	4.79	5.09	50.59
1976	0.95	1.87	4.37	1.30	2.45	5.61	8.17	0.56	0.38	2.50	0.24	1.54	29.94
1977	2.80	2.87	10.25	3.00	3.22	5.30	2.42	7.98	6.73	1.23	5.10	4.42	55.32
1978	1.67	1.42	5.91	1.68	3.43	1.66	5.25	5.14	0.74	1.76	5.81	5.05	39.52
1979	2.42	5.15	8.56	7.41	6.29	2.69	5.44	5.12	1.26	1.69	5.68	3.58	55.29
1980	1.32	2.35	4.25	1.52	3.77	1.95	0.99	2.48	4.85	2.38	2.53	1.12	29.51
MEAN	2.51	2.87	5.44	4.77	4.37	3.93	4.04	4.40	3.77	2.64	4.51	4.06	47.77

Table 4.--Number of days with a maximum temperature of 90° F or more in Van Buren, MO from 1970-1980

Year	Month							Total
	A	M	J	J	A	S	O	
1970	1	0	8	17	12	8	0	46
1971	0	0	17	15	11	7	1	51
1972	1	2	14	18	12	10	0	57
1973	0	1	7	24	16	2	0	50
1974	0	0	2	25	6	0	0	33
1975	0	2	0	23	16	4	1	46
1976	0	0	2	16	11	3	0	32
1977	0	0	7	19	15	6	0	47
1978	0	4	5	23	18	8	0	58
1979	0	0	8	9	10	4	1	32
1980	2	0	14	29	31	18	2	76
MEAN	0.4	0.8	7.6	19.8	14.4	6.4	0.4	48

Table 5.--Number of days with a minimum temperature of 0° F or less in Van Buren, MO from 1970-1980

	Month						
Winter	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1970-71	0	0	0	1	2	0	3
1971-72	0	0	0	2	2	0	4
1972-73	0	0	0	0	0	0	0
1973-74	0	0	2	2	0	0	4
1974-75	0	0	0	0	0	0	0
1975-76	0	0	0	2	0	0	2
1976-77	2	1	1	13	1	0	18
1977-78	0	0	0	1	1	1	3
1978-79	0	0	0	9	3	0	12
1979-80	0	0	0	0	4	0	4
MEAN	0.2	0.1	0.3	3.0	1.3	0.1	5